Design of Cognitive Tutor to Diagnose the Types of Intelligence in Preschool Students from Ages 3 To 5

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Abstract. The relationships between preschool, employment and economic productivity, as well as cost-benefit studies in this field, show a potential high return on investment in the early years of childhood. Preschool is the main base of the educational structure according to the Peruvian Ministry of Education. However, investment in this type of education is on average about 250 soles ($77) per student. On average there is one teacher per 18 students and just 60% of these teachers are specialized in preschool education (Escale,2015). In this context, talking about equal opportunities have been contradictory because these kinds of students have been part of the population that has not generated productivity in the country. On the other hand, when talking about the productivity of people, this could have a direct correspondence with the innate capacity that people have (Cerquín Cortez,2017), which are call like intelligences according to Howard Gardner in the theory of seven intelligences. Could you imagine that we can detect these intelligences in the first years of a child? This gives us an opportunity to improve our abilities in the coming years. For several years, student abilities have gone unnoticed because of curricular education and even now continue to remain the same. Although there are current methodologies designed for the diagnosis of these types of intelligences in early education, this could go unnoticed given the inexperience of the teacher and excessive workload as well as the need of psychologists for its proper application. In contrast, increasing the use of technology could be to our benefit. This work proposes the development of a cognitive tutor to diagnose the types of intelligence in preschool aged children in rural areas with teachers without an educational degree and little to no presence of psychologists.

Keywords: Artificial Intelligence, Expert System / Cognitive Tutor, Model of Intelligence Types, Cognitive Science, Preschool Education.

1 Introduction

The research proposes a change of context in the curricular plan of early childhood education, in children aged 3 to 5 years, who have put aside the traditional school practice of prioritizing linguistic and logical mathematical skills over the rest of the skills a human can display and develop. This traditional school practice led to diagnose and evaluate students based on these types of skills which in turn led to overseeing the abilities of several students who did not fit the traditional system well (Grana-

dos,2004). Because some students could have been high-lighted in other areas of abilities, reveals the high rates of injustice in primary and secondary education (Minedu,2019). Inequality is more prominent in rural contexts due to high poverty rates generating clear differences in the level of learning provided in each social sector (Escale,2015).

According to several analyses, poverty was one of the variables. It was found that poor students have less access to education and attend schools that do not offer all the basic services and whose teachers do not have enough training, which generates gaps in educational outcomes (Cueto,2019). For this reason, education must combat the large educational gap based on poverty levels that causes an inequity in the quality of education which does not differentiate the scarce resources for a large percentage of the population. In the same way, considering one of the six objectives of the National Educational Project and the Educational Policy guidelines that are mentioned in the Peru Plan by 2021, created by the National Center for Strategic Planning (CEPLAN) which provides the guidelines of the educational policy intended to eliminate the gaps between public and private education, and between rural and urban education, addressing cultural diversity. (Minedu,2019). According to the general context described, the problem that the thesis aims to solve is the inequity in the quality of education for all, thus eliminating the gap between public and private education. For which, the main components will be technology and Internet access which the largest number of Peruvian populations currently possesses (INEI,2012). The thesis aims to develop a cognitive tutor that supports the work of preschool teachers. The researcher considers preschool education as one of the main pillars given the current structure of education (Minedu,2019). Artificial intelligence (AI) technology, developed by IBM Watson, is an open and multi-cloud platform that allows you to automate the life cycle of the AI will be used to design the cognitive tutor. Powerful models will be created from scratch or to save time, preconfigured business applications may be used. The main objective of this thesis is to enhance education using technology; it is not a thesis of education itself. We will use a model of intelligence types previously validated in the thesis from the University of Seville, Spain, entitled "INTELIGENCIAS MÚLTIPLES EN LA EDUCACIÓN INFANTIL" (MULTIPLE INTELLIGENCES IN CHILDHOOD EDUCATION). Consequently, the validation of the methodology of the model is not subject of this investigation. The processing model in the cognitive tutor using Watson, will be carried out with a personalized design using the expert system. AI will be used to generate knowledge in Watson allowing the cognitive tutor to identify intelligence types based on the criteria of the teacher which in turn will be validated through the future interaction with the child.

2 Problem

The research will attempt to resolve the problem of inequity in the quality of education as the main cause to learning problems in early child-hood education. For more than 10 years, incentives to improve education have increased because of the participation of public and private entities who consider education as a key to achieve cul-

tural change in Peruvian society (Cueto, 2019). However, inequality remains due to the poverty variable detected in different investigations, where the number of children and young people involved is 1.3 million in initial education, 3.7 million in primary education and 2.5 million in secondary education, of which 79% of them are enrolled in public educational institutions (Guadalupe, León, Rodríguez y Vargas, 2017).
In initial education (pre-school and kindergarten), there are more than 11,000 state educational centers and more than 18,000 non-governmental programs that serve 994 thousand children under the age of six. In contrast, the number of qualified teachers (teachers with a teaching degree associated with the level that they teach) working in these educational centers is 60% work in preschool INEI,2017). In a State that promotes equality, the most qualified teachers should teach children who belong to vulnerable groups. The Teacher Reform encourages the participation of teachers in educational institutions of EIB (Education International Bilingual). However, it does not generate enough incentives for the most qualified teachers to teach in institutions that underprivileged students attend. It is in this context that initiatives to eliminate the gaps between public and private education, and between rural and urban education will take place. Addressing cultural diversity should be a priority from all existing professional fronts as well as using existing advanced technological resources such as an Artificial Intelligence (AI) program. AI is one of the main tools that could support the simulation of a psychologist to reinforce the student's education with minimal cost alleviating the need for a psychologist for each student.

2.1 Problem Formulation

The problem is clearly formulated by posing the following research question:

What is the impact of cognitive tutor to diagnose the types of intelligence in the education of students from ages 3 to 5 in childhood education?

General Objectives. Evaluate the impact of a cognitive tutor to diagnose the types of intelligence in students from ages 3 to 5 in childhood education.

Specific Objectives

Reproduce the diagnostic methodology of the types of intelligence using a cognitive tutor program in IBM IA Watson.

Testing the prototype of the cognitive tutor to diagnose the types of intelligence in students from ages 3 to 5 in childhood education.

Evaluate the impact of the cognitive tutor to enhance the types of intelligence in students from ages 3 to 5 in childhood education.

3 Theoretical Basics

Research about the recognition of mathematical talent (Palvlekovic and Zekic'-Susac, 2007) concludes that recognition of this talent needs the joint work of a psychologist and the teacher. Schools do not usually have the possibility of hiring both professionals due to different factors. Therefore, an expert system was developed with the objective to enhance teacher decision making by simulating previously defined knowledge of psychologists. In conclusion, the use of the expert system to support the decision making of a teacher could achieve an increase in the recognition of mathematical talent in students. Likewise, the use of similar AI programs is recommended for learning development in schools.
The integration of two AI methods such as: Expert Systems and Artificial Neural Networks, as a decision support tool for teachers in the recognition of gifted children were tested and produced similar results. These tools are usually used in tutoring systems to support learning or to teach a specific topic and are rarely considered for the diagnosis of skills. (Pavlekovic, M. and Zekic.Susac, 2008) In conclusion, other research supports using the methodology of neural networks and fuzzy logic for the process of diagnosing a gifted student in an educational system with the objective to simulate the evaluation of the teacher to identify the characteristics of a student for the selection of a learning system that suits him. (Stathacopoulou, Magoulas y Grigoriadou,1999).

4 Theoretical Framework

4.1 Artificial intelligence

It is a field that aims to solve complex problems with the following areas of interest: Vision, Natural Language, Expert System, Reading Compression, Robotics, Speech and Neural Networks. (Giarratan, 1998) & (Lahoz-Beltrá, 2004).

4.2 Expert System

Responsible for reproducing the knowledge of a specialist or specialized professional in a specific branch to solve complex problems. (Giarratan, 1998) & (Kendall, 2011).
The traditional elements of an expert system are (Giarratan, 1998):

User Interfaces: allows communication between the system and the user

Means of Explanation explains to the user the reasoning of the system

Active Memory: a global database of the facts used by the rules

Mechanism of Inference makes inference to decide which rules meet the facts or objects; gives priority to the rules met

Agenda: a list of priorities assigned to the rules created by the inference mechanism, whose patterns satisfy the facts or objects of active memory

Medium for the Acquisition of Knowledge: automatic way for the user to introduce data to the system without needing an engineer to code this explicitly

4.3 Multiple Intelligence

This theory, according to the author, proposes seven intelligences which have been widely investigated and documented (Granado,2004):

Musical intelligence includes sensitivity to rhythm, tone, melody, timbre and pitch.

The kinetic-body intelligence appeals to multiple skills such as the ability to use the body to express ideas or feelings, to overcome obstacles, or to achieve certain objectives in various situations and includes manual skills to build or transform things and handle objects with dexterity.

Logical-mathematical intelligence includes sensitivity to schemas and logical relationships, affirmations and propositions (if-then, cause-effect), functions, inferences, abstractions.

Linguistic intelligence implies sensitivity to sounds or phonemes, syntax or structure of language, semantics or meanings of language and different uses of language, such as rhetoric or persuasion.

Space intelligence is the ability to perceive the visual-spatial world and to realize transformations based on that perception.

Intrapersonal intelligence refers to self-knowledge and the ability to adapt to one's own ways of acting.

Interpersonal intelligence is the sense of oneself and constitutes a mixture of intrapersonal and interpersonal components.

4.4 Cognitivism and Theory of Information Processing

Studies of internal processes during learning and memory structures are proposed and subjected to validation models that explain how the human mind learns and retains that information. The theories of information processing are based on analogies with computational machines. Memory is a structure of interrelated knowledge which can be schematically visualized as a network in which each union (node) is a fact of and each arrow represents the interrelation with another fact of. An act of learning consists of three things (Norman,1980):

Initially, there is existing knowledge at a given moment.
New knowledge, C1 and C2, is interconnected by the relationship R but not yet assimilated and accommodated in the memory structure.

The new knowledge, it has been properly connected with the previous one, which can now be distinguished between the new and previously existing knowledge. now be distinguished between the new and previously existing knowledge.

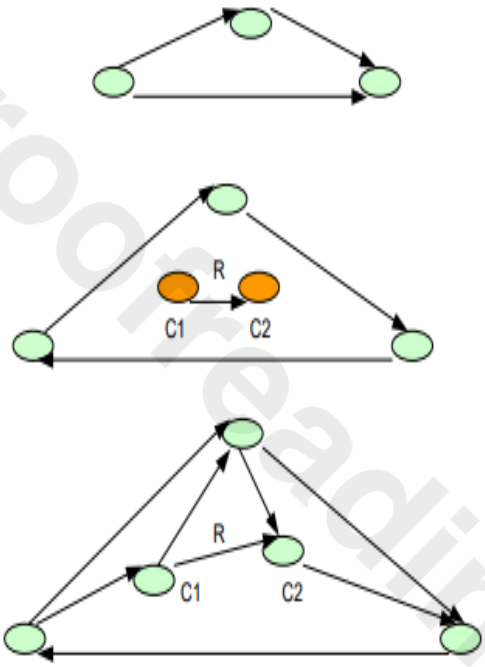

Fig. 1. Process to improve the knowledge

Learning from this perspective focuses on incorporating new learning into the memory structure and being able to repair and use it when necessary. This form of teaching, therefore, focuses on ensuring that the student will fill in the gaps in that memory structure.

5 Contributions of the Autor

Currently the use of artificial intelligence is cogitating a high visibility from different areas of business, given the optimization of human resources that causes. Considering also the easiest Internet access to which children begin to access. As a thesis student, I think it is important to raise the use of AI to simulate the profiles of different critical experts to improve a child's education. Especially at an early age. So, the direct contribution of my thesis is to try to prototype the knowledge of a psychologist

embodied in a methodology to detect types of intelligence in a child in pre-school education. Trusting to continue with the work already done by different experts to use technology in education and trusting to impact other colleagues who could continue to implement technology in our education that needs to take more and more giant steps so as not to fall behind in a century like the actual

6 Research Method

The research will simulate the diagnostic methodology of multiples intelligences using a cognitive tutor.

Phase 1: To achieve the re-production of the diagnostic methodology of the types of intelligence in a cognitive tutor using IBM IA Watson, the following activities must be carried out:

Representation of the diagnostic methodology of the types of intelligence in a sematic network used by a cognitive tutor.
Preparation of a related database for the registration of facts that match with knowledge to generate new facts.
Determine the actions for the inference engine for the cognitive tutor using IBM IA Watson.
Development of interface to interact with the user.

Phase 2: to test the prototype of the cognitive tutor to diagnose the types of intelligence in students from ages 3 to 5, the teacher should carry out the following activities:

Student registration.
Determination of the suggested profile of the student by types of intelligence.
Create an activity plan according to the student's profile.
Registration of interaction with activities suggested by the profile.
Registration of interaction with activities not suggested by the profile.
Determination of the user's profile by intelligence types according to interaction with the system.

Phase 3: to evaluate the impact of the cognitive tutor to boost the types of intelligence in students from ages 3 to 5 in childhood education, the following activities must be performed:

Comparison of the profile according to interaction with the system of intelligence types.
Comparison of average profile matches.
Suggested and the profile according to interaction with the system of intelligence types.

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